ÖGH Herpetozoa
Austrian Herpetological Society

Herpetozoa 33: 213–215 (2020)
DOI 10.3897/herpetozoa.33.60163

A case of color aberration in a fire salamander (*Salamandra salamandra*) larva

Sabina Elena Vlad[1,2,4], Dan Cogălniceanu[1,2], Raluca Ioana Băncilă[1,2,3], Florina Stănescu[1,2,4]

1 *Ovidius University Constanţa, Faculty of Natural and Agricultural Sciences, Al. Universitatii 1, corp B, 900740 Constanta, Romania*
2 *Chelonia Romania, Bucharest, Romania*
3 *"Emil Racoviţă" Institute of Speleology, 13 Septembrie, 050711 Bucharest, Romania*
4 *CEDMOG Center, 145 Tomis Av, Constanta, Romania*

http://zoobank.org/C637E671-109D-40BC-9660-702FC19B9872

Corresponding author: Dan Cogălniceanu (dcogalniceanu@univ-ovidius.ro)

Academic editor: Günter Gollmann ♦ **Received** 29 October 2020 ♦ **Accepted** 26 November 2020 ♦ **Published** 21 December 2020

Abstract

Color aberrations in salamanders are caused by defective chromatophores or by disrupted synthesis of the pigments, and have been previously reported in Europe. In this paper we report the first case of leucism in a fire salamander larva from a cave-dwelling population in Romania. The leucistic larva was larger and heavier compared to the other larvae from the same breeding habitat.

Key Words

Amphibia, cave, leucism, Romania

The fire salamander *Salamandra salamandra* is present in most of continental Europe, except for the Baltic and Nordic countries (Steinfartz et al. 2000; Kuzmin et al. 2009). Adults inhabit mainly deciduous and mixed forests and can be easily recognized by their distinct color pattern – black background with yellow-orange large spots. However, it is a highly polymorphic species, and colorations that may appear as anomalies in one subspecies are common in some populations and part of the normal coloration in other subspecies (Seidel and Gerhardt 2016 in Henle et al. 2017).

Conditions such as albinism, when pigmentation is lacking completely, or leucism, when pigments are present in a lower amount than normal, are among the most common color aberrations in wild amphibian populations and are induced by defective chromatophores (McCardle 2012), or when the chromatophores are fully functional, by disrupted synthesis of the pigments (Frost-Mason et al. 1994). The first albino fire salamander was reported in the 17th century (Wurffbain 1683 in Henle et al. 2017), and ever since it was proved that the absence of pigmentation is not uncommon both in this species (e.g. Varga 2010; Moore and Ouellet 2014; Gergely 2016; Lunghi et al. 2017) and in other salamanders (e.g. McCardle 2012; Lunghi et al. 2017; Hartzell 2020). Nonetheless, the background rates of albinism in amphibians from presumably unaltered habitats are usually much lower than 1% (Henle et al. 2017), and sometimes larvae lacking pigmentation develop a yellow pattern after metamorphosis (Pastors and Greven 2016 in Henle et al. 2017). In this paper we report the first case of color aberration in the larval stage of a cave-dwelling population of *Salamandra salamandra* from Romania.

During a herpetological survey carried out in April 2017 in South-Western Romania, we checked a known breeding habitat of the fire salamander inside the cave Gaura cu Muscă (44.66472°N, 21.69916°E, 100 m elevation a.s.l.). The cave is located within a compact karstic area (Bădescu and Tîrlă 2020), very close to the Iron Gates Reservoir. Numerous larvae in different stages of

Copyright *Sabina Elena Vlad et al.* This is an open access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Figure 1. Leucistic larva of *S. salamandra* found in the cave Gaura cu Muscă, Romania (**a, b**); fire salamander larvae with normal coloration found in the same location (**c, d**). Photographs by F. Stănescu.

development occurred in the semi-permanent, shallow ponds formed at the entrance of the cave. Among them, one individual presented a much depigmented appearance. We used a small net to capture as many larvae as possible, and checked for the presence of other individuals with color aberrations. We measured the wet body mass on site by placing each larva in a plastic cup filled with water on an electronic pocket scale (Pesola, 0.01 g accuracy). We photographed each larva inside a plastic container, next to a piece of laminated millimeter paper, and used the photographs to measure the total body length with the software ImageJ v. 1.50i (Schindelin et al. 2012).

Only one in 44 larvae presented the abnormal coloration. Since melanophores and xanthophores were present in a very small amount and the eyes had a normal coloration (Fig. 1), we considered the observed aberrant coloration as leucism, following Henle et al. (2017). The rest of the larvae (n = 43) found within the same habitat presented the normal color phenotype, characteristic to the larval stage of the fire salamander. We calculated the upper and lower 95% confidence intervals for the total length (mean ± SD: 39.72 ± 5.71 mm) and body mass (mean ± SD: 0.34 ± 0.13g) of the normal colored larvae. Both measurements of the leucistic larva (46.06mm and 0.55g) are situated above the 95% CI [37.97, 41.48] for total length, and respectively 95% CI [0.30, 0.39] for body mass. This contrasts with the results of Varga (2010) who reported a leucistic *S. salamandra* larva smaller than the rest of larvae in the cohort, or Gergely (2016) who reported no difference in size between a leucistic larva of the same species and the rest of the cohort.

During the past ten years, only a handful of studies reported color aberrations in *S. salamandra*, from populations in Hungary (Börzsöny Mountains, partial albinism in one larva, Varga 2010; Gergely 2016) and Italy (Lombardy, partial albinism in four larvae, leucism in one adult; South Tyrol, leucism in one adult, Lunghi et al. 2017). Several older records of color aberrations are reported by Arribas and Rivera (1992), for populations of the fire salamander from Spain, and in the review studies by Seidel et al. (2012) and Henle et al. (2017), for populations from France and Germany. To the best of our knowledge, this is the first report of color aberration observed in larvae of the fire salamander from a cave habitat. In addition, previous studies regarding amphibians from Romania reported so far only one case of an albinistic frog, i.e., a specimen of *Pelophylax ridibundus* found in a mining habitat (Adlassnig et al. 2013), and morphological

anomalies such as malformations and polydactyly (e.g. Székely and Nemes 2003; Sas and Kovacs 2006).

In fire salamanders, the color pattern of both terrestrial and aquatic life-stages helps the animals to blend in with the natural environment, while also signaling the presence of toxic secretions to potential predators (i.e., aposematic coloration). Thus, the lack of pigmentation might lead to a shorter lifespan in nature due to increased conspicuousness to predators (Fertl and Rosel, 2009) or affect the thermoregulation due to the lack of the black pigment (Trullas et al. 2007); however, this will not affect cave-dwelling individuals.

Acknowledgements

RB received support through grants no. PN-II-RU-TE-2014-4-1536 and PN-III-P1-1.1-TE-2019-1233; FS is supported by the project ANTREPRENORDOC, in the framework of Human Resources Development Operational Programme 2014–2020, financed from the European Social Fund under the contract number 36355/23.05.2019 HRD OP /380/6/13 – SMIS Code: 123847, and by grant PN-III-1.2-PCCDI-2017-0721 (INTERASPA).

References

Adlassnig W, Sassmann S, Grawunder A, Puschenreiter M, Horvath A, Koller-Peroutka M (2013) Amphibians in metal-contaminated habitats. Salamandra 49(3): 149–158.

Arribas O, Rivera J (1992) Albinismo en *Salamandra salamandra* (Linnaeus, 1758) en el noreste ibérico. Boletín de la Asociación Herpetológica Española 3: 14–15.

Bădescu B, Tîrlă L (2020) Harta carstului din România. Reşiţa: Pro Marketing.

Fertl D, Rosel PE (2009) Albinism. In: Perrin WF, Würsig B, Thewissen JGM (Eds) Encyclopedia of marine mammals. Academic Press, 24–26. https://doi.org/10.1016/B978-0-12-373553-9.00006-7

Frost-Mason SK, Morrison R, Mason K (1994) Pigmentation. In: Heatwole H, Barthalmus GT (Eds) The Integument. Amphibian Biology 1: 64–97.

Gergely K (2016) New observation of a partially albinistic *Salamandra salamandra* in Hungary (Amphibia: Caudata: Salamandridae). e-Acta Naturalia Pannonica 10: 17–20.

Hartzell SM (2020) An amelanistic Spotted Salamander, *Ambystoma maculatum* (Caudata: Ambystomidae) from Eastern Pennsylvania. Herpetology Notes 13: 179–180.

Henle K, Dubois A, Vershinin V (2017) A review of anomalies in natural populations of amphibians and their potential causes. In: Studies on anomalies in natural populations of amphibians. Mertensiella 25: 57–164.

Kaczmarski M (2018) Częściowy albinizm czy wyjątkowo jasno ubarwiony osobnik ropuchy szarej *Bufo bufo* w Poznaniu? Wszechświat 119: 7–9.

Kuzmin S, Papenfuss T, Sparreboom M, Ugurtas IH, Anderson S, Beebee T, Denoël M, Andreone F, Anthony B, Schmidt B, Ogrodowczyk A, Ogielska M, Bosch J, Tarkhnishvili D, Ishchenko V (2009) *Salamandra salamandra*. The IUCN Red List of Threatened Species 2009. [Downloaded on 26 October 2020]

Lunghi E, Monti A, Binda A, Piazzi I, Salvadori M, Cogoni R, Riefolo LA, Biancardi C, Mezzadri S, Avitabile D, Manenti R, Mulargia M, Manca S, Blaimont P, Di Cerbo AR, Ficetola GF (2017) Cases of albinism and leucism in amphibians in Italy: new reports. Atti della Società Italiana di Scienze Naturali e del Museo Civico di Storia Naturale di Milano 4: 73–80. https://doi.org/10.4081/nhs.2017.311

McCardle H (2012) Albinism in Wild Vertebrates. MSc thesis. San Marcos, Texas: Texas State University.

Moore JD, Ouellet M (2014) A review of colour phenotypes of the Eastern Red-backed Salamander, *Plethodon cinereus*, in North America. The Canadian Field-Naturalist 128(3): 250–259. https://doi.org/10.22621/cfn.v128i3.1603

Pastors J, Greven H (2016) Die schwierige Klassifizierung von Farbabweichungen bei einheimischen Amphibien. Feldherpetologisches Magazin 5: 8–15.

Sas I, Kovacs EH (2006) Hexadactyly case at a *Rana* kl. *esculenta* sample from the north-western part of Romania. Analele Universităţii din Oradea – Biologie 2(1): 1–16.

Schindelin J, Arganda-Carreras I, Frise E, Kaynig V, Longair M, Pietzsch T, Preibisch S, Rueden C, Saalfeld S, Schmid B, Tinevez J, White DJ, Hartenstein V, Eliceiri K, Tomancak P, Cardona A (2012) Fiji: an open-source platform for biological-image analysis. Nature Methods 9(7): 676–682. https://doi.org/10.1038/nmeth.2019

Seidel U, Hartmann E, Hein A (2012) Farb- und Zeichnungsanomalien beim Feuersalamander (*Salamandra salamandra*). Amphibia 11(2): 4–19.

Seidel U, Gerhardt P (2016) Die Gattung *Salamandra*. Chimaira, Frankfurt-Germany, 543 pp.

Steinfartz S, Veith M, Tautz D (2000) Mitochondrial sequence analysis of *Salamandra* taxa suggests old splits of major lineages and postglacial recolonizations of Central Europe from distinct source populations of *Salamandra salamandra*. Molecular Ecology 9(4): 397–410. https://doi.org/10.1046/j.1365-294x.2000.00870.x

Székely P, Nemes S (2003) The incidence of mutilations and malformations in a population of *Pelobates fuscus*. Russian Journal of Herpetology 10(2): 145–148.

Tavares-Pinheiro R, Costa-Campos CE, Kaefer IL (2020) A leucistic brilliant-thighed poison frog *Allobates femoralis* (Dendrobatoidea). Herpetology Notes 13: 321–323.

Trullas SC, van Wyk JH, Spotila JR (2007) Thermal melanism in ectotherms. Journal of Thermal Biology 32(5): 235–245. https://doi.org/10.1016/j.jtherbio.2007.01.013

Varga J (2010) Részlegesen albínó foltosszalamandra-lárva észlelése Magyarországon. Állattani Közlemények 95(2): 305–309.